Eglinton Valley Lesser Short-Tailed Bat Monitoring Programme 2014/2015

Department of Conservation
Te Papa Atawhai

newzealand.govt.nz

Eglinton Valley Lesser Short-Tailed Bat Monitoring Programme 2014/2015

Hannah Edmonds and Moira Pryde

April 2015

Cover image credit (Graham Dainty): Lesser short-tailed bat, Eglinton Valley 2015

Hannah Edmonds
Department of Conservation
Fiordland District Office
PO Box 29 Te Anau 9600

Moira Pryde
Department of Conservation
Science & Capability
Christchurch

TABLE OF CONTENTS

Summary

The population of South Island lesser short-tailed bats (*Mystacina tuberculata tuberculata*) in the Eglinton Valley is the only known viable population of this species on mainland South Island.

The Eglinton Valley is an ecologically important site as it is one of the only sites in the South Island with both species of bats: long-tailed bats (*Chalinolobus tuberculata*) and lesser short-tailed bats. It is also a stronghold for populations of mohua, kaka and kakariki. Continuous stoat control and periodic rat and possum control programme is in place in the valley to protect these species.
The Eglinton Valley lesser short-tailed bat monitoring programme is a long-term investment with the main aim of monitoring the population survival between years and trend over time using the mark-recapture method, and analysing data using Program MARK to assess the effectiveness of predator control in the valley.

An aerial 1080 operation was conducted over 10,300ha in the Eglinton Valley on the 12th December 2014 as a response to a rat plague event. This provided an opportunity to measure the effects of an aerial 1080 operation on a well marked lesser short-tailed bat population.

This report describes the monitoring of the lesser short-tailed bat population before, during and after the 1080 operation as well as the annual population survival monitoring in January 2015.

- Automatic readers and dataloggers were set up at all known occupied roosts and 965 PIT-tagged bats were recorded
- 774 PIT-tagged bats were recorded prior to the 1080 operation (27/11/14-12/12/14) and 763 of these were recorded in the period following the 1080 operation (19/12/2014- 4/2/15)
- Eight nights of bat activity were recorded at roosts after the 1080 operation to view for signs of poisoning in the event any bats were found missing
- Bats were captured in mist-nets and harp-traps returning to their roosts to check for signs of poisoning during two mornings after the 1080 operation. None exhibited any adverse effects
- Bat faeces and one dead baby bat were collected from a roost to test for 1080 toxicology. The bat faeces came back clear, however the baby bat had 0.013 µg/g 1080 in muscle tissue
- The highest count of bats emerging from one roost tree, via video recordings, was 1731 (n=17), which is the highest count ever recorded
- A proportion of the population (231 bats) were marked with PIT-tags, bringing the total PIT-tagged to 1969. Recaptures indicate we have PIT-tagged more than 50% of the current population
- More staff were trained as PIT- tag handlers
- The annual “Birds, Bats and Barbeques” event was successful in advocating bat conservation to the local community

1. Introduction

The South Island lesser short-tailed bat is ranked under the New Zealand Threat Classification System as nationally endangered (O'Donnell et. al., 2010). Both species of bats in New Zealand are vulnerable to introduced predators (rats, stoats, feral cats) throughout the year; in summer when they congregate in large colonies, and during winter when they may remain inactive (in torpor) within roosts.

The Bat Recovery Group recognises the lesser short-tailed bat population in the Eglinton Valley as a priority for management, with the aim of maintaining long-term security of the population. The lesser short-tailed bat monitoring programme is a long-term project and compliments the suite of monitoring in the valley, resulting in a unique project with one of the longest histories and the broadest scope in the country.

Informal monitoring began in 1997 when lesser short-tailed bats were discovered in the Eglinton Valley for the first time. Initially, the bats were monitored in an ad hoc fashion by conducting counts at roost sites using infra-red video-cameras and VHS SD card recorders to record bats as they exit their roost trees at night. Sampling effort has varied considerably from year to year, but a focused video-monitoring programme began in 2005. Video-monitoring of roost emergence is a useful monitoring tool; however it has limitations as it is almost certainly an under-estimate of the lesser short-tailed bat population. Bats often emerge from several holes in a roost tree and frequently move roost sites. Roost exit counts are therefore not thought to be as sensitive at detecting changes in populations as mark-recapture analysis.

Mark-recapture analysis of banded long-tailed bats in the Eglinton Valley detected changes in populations that other monitoring methods (such as transects) failed to pick up (Pryde et al., 2005; Pryde et al., 2006).

Mark-recapture analysis requires animals to be individually identified in order to calculate estimates of population size and survival. Forearm banding with uniquely numbered metal bands is the accepted technique for long-term marking of long-tailed bats. However, captive trials using a range of bands on lesser short-tailed bats indicated that bands caused swelling in forearm tissue and unacceptable damage to both forearm and wing (e.g. Lloyd, 1995; Sedgeley & Anderson, 2000). For this reason there was an urgent need to develop alternative marking techniques.

The lesser-short-tailed bat monitoring began in 2006 as collaboration between Dr Jane Sedgeley, Warren Simpson and Hannah Edmonds, Kate McInnes, DOC wildlife vet and wildlife health technician and Stu Cockburn, conservation electronics manager. The original aim of this study was to assess if passive integrated transponder tags (PIT-tags, transponders or micro-chips) are suitable for marking and monitoring population trends in lesser short-tailed bats in the Eglinton Valley. We decided to continue with the existing video-monitoring programme in order to evaluate the relative merits of each technique.

Initial work has led us to be confident that we have successfully pioneered the PIT-tagging procedure for lesser short-tailed bats. The focus of the project is now long-term monitoring of the population trends in relation to pest management. Five or more PIT-tagging sessions are conducted at communal roost trees throughout the month of January, to reach the required target of 200+ PIT-tagged bats per annum.

Invasive animal pests such as stoats, cats, rats and possums are controlled to protect a range of threatened native species present in the valley. Monitoring of mustelid and rodent abundance and survival of several threatened species is conducted each year. Long-tailed bats in the Eglinton Valley appear to be increasing slowly following a number of 1080 and pindone operations in bait stations aimed at controlling rats. However, because both species of bats only give birth to single young, once a year, recovery will be slow and difficult to detect in the short term, hence requiring a long-term commitment.

The size and scope of the rat control has varied over the years, and currently consists of a 100x100m bait station grid covering 4800ha of the Eglinton Valley. A pre-fed aerial 1080 operation, as part of the Battle for our Birds initiative was conducted over 10,300ha on the 12th December 2014, due to rising rat numbers in the valley.

The survival of short-tailed bats through aerial 1080 operations has only been monitored during one operation in central North Island (Lloyd & McQueen 2002), while the study concluded no major mortality, no such study has been conducted in the South Island beech forest with a marked population.

2. Objectives

2.1 Monitoring lesser short-tailed bat survival through an aerial 1080 operation

Aim

To estimate lesser short-tailed bat survival in the Eglinton Valley prior to, during and following the aerial 1080 operation.

Outcome measures

1. Proportion of PIT-tagged (individually marked) bats alive immediately before, during and following the poison operation. Analyse data using mark-recapture data to gain survival estimates before the poison operation (November, early December), 1 week after (December) and in January/February using Program Mark.
2. Proportion of bats caught at dawn at roosts or on foraging grounds displaying symptoms of poisoning.
3. Number of dead bats found at roost sites.

2.2 Monitoring lesser short-tailed bat annual survival

Aim

To estimate lesser short-tailed bat survival and population size in the Eglinton Valley from year to year, in relation to the current pest control regime.

Outcome measures

1. Record PIT-tagged bats via automatic readers and dataloggers at all roosts found.
2. Insert new Passive Integrated Transponder (PIT) tags into at least 200 bats.
3. Analyse population data using Program Mark to gain survival estimate between years.
4. Film and count bats emerging from roosts as a secondary monitoring method.

3. Methods

3.1 Monitoring lesser short-tailed bat survival through an aerial 1080 operation

1. Estimate Minimum Number Alive and survival using mark-recapture with PIT- tagged bats and automatic data loggers at roosts.
    a. Find active roosts using radio-tagged bats (tagging more if losing track of location of active communal roosts)
    b. Follow radio tagged bats to roosts, set up antennae around roost holes, set up data loggers
    c. Monitor for c.2 weeks prior to, then continuously at least until 2 weeks post aerial 1080 operation.
    d. Repeat monitoring c.1 month later (January-February)
    e. Calculate survivorship using minimum number alive (MNA; O'Donnell 2009) and mark-recapture to assess any potential effects of use of the toxin.
2. Monitor short term health of bats caught at roost sites and on their feeding grounds following the 1080 drop.
    a. Catch and hold bats 2-3 hours before dawn (as they return from feeding) on two fine nights immediately following the 1080 drop (using harp traps at tree roosts). Aim to catch >100 bats.
    b. Mist-net bats in locations that are suspected feeding grounds 2-3hrs after emergence on two fine nights immediately following the 1080 drop and hold bats for 1-2 hrs in bags in situ to assess response (if any) to potential exposure to toxin. Several teams will be required to maximise sample sizes. Aim to catch >10 bats.
    c. Record any symptoms (lethargy, seizures, signs of green dye on body)

3. Climb and check roost sites for dead bats (on ground and in roost cavities) every three days after 1080 drop, until baits are deemed non-toxic. Obtain autopsy reports as per the DOC SOP.

3.2 Monitoring lesser short-tailed bat annual survival

1. Estimate survival between years by using mark-recapture with PIT-tagged bats and automatic data loggers at roosts.
    a. Find active roosts using radio-tagged bats (tagging more if losing track of location of active communal roosts).
    b. Follow radio tagged bats to roosts, set up antennae around roost holes, set up data loggers
    c. Monitor for a minimum of three weeks throughout January
    d. Calculate survival using mark-recapture

2. Insert new Passive Integrated Transponder (PIT) tags into at least 200 bats.
    a. Catch bats at active communal roosts, and insert PIT-tags into new unmarked bats as per Best Practise Manual for Conservation Techniques for Bats (Sedgeley et. al., 2012).Record recaptured bats. Record age, sex and reproductive status of all bats.

3. Film and count bats emerging from roosts as a secondary monitoring method.

a. Follow radio tagged bats to roosts, set up cameras and recorders to film for 2 hours during emergence (10pm to midnight).
b. Count all recorded emergence from videos using roost count
c. Compare and graph results

4. Results

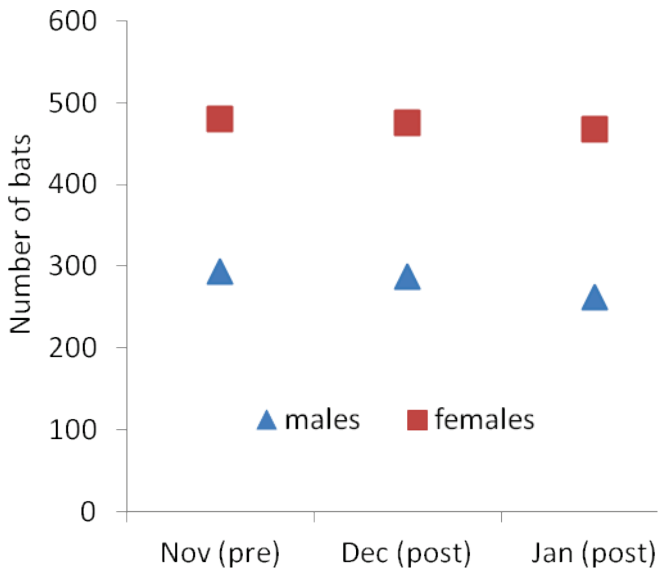
4.1 Monitoring lesser short-tailed bat survival through an aerial 1080 operation

Five female bats had transmitters attached to them during November/December. Bats were tracked to six communal roost trees in the Murcott Burn area, three of these roosts were previously unknown. Data loggers were set up on roost trees and registrations logged, prior to and after the 1080 operation. 774 PIT-tagged bats were recorded prior to the 1080 operation (27/11/14 to 12/12/14) and 763 of these were recorded in the period following the 1080 operation (19/12/2014 to 4/2/15).

Table 1.

Age - sex class	Nov 2014 (pre 1080)	Dec 2015 (post 1080)	Jan 2015 (post 1080)
Adult male	269	262	240
Juvenile male	25	25	23
Total males	**294**	**287**	**263**
Adult female	452	448	442
Juvenile female	28	28	26
Total females	**480**	**476**	**468**
Total of all bats	**774**	**763 (98.6%)**	**731 (94.4%)**

Figure 1. Estimated number of male and female bats recorded before and after the 1080 drop (using the simplified method of minimum number alive, MNA).



Survival analysis using the robust model showed that survival was dependent on sex and time. The effect of immigration and emigration was tested in the model and there was no significant improvement ($\Delta AICc<2$) (Table 2). The estimated population declines in the second session in a model that allows immigration/emigration (Fig. 2) but does not decline in the model with emigration/immigration (Fig.3). This shows that the drop in numbers is behavioural due to immigration and emigration rather than a decline in numbers. Survival rates were high (0.99 for both males and females) for the model with immigration/emigration and lower for a model without immigration/emigration (males 0.89, females 0.97). The lower survival in males in the model without immigration/emigration is likely to be explained by the fact that adult males are less likely to be caught compared to adult females as they tend to roost alone and only intermittently join the maternal roosts (O'Donnell 2002).

Table 2. Models tested in Program Mark.

Model name	AICc	Delta AICc	AICc weight	Model likelihood	No of parameters	Deviance
Survival dependent on sex and time with no emigration/immigration	6395.74	0	0.65	1.00	148	18302.96
Survival dependent on sex and time with emigration/ immigration	6396.95	1.2	0.35	0.55	154	18291.75

Figure 2. Modelling of the population using a model that allows for immigration/emigration

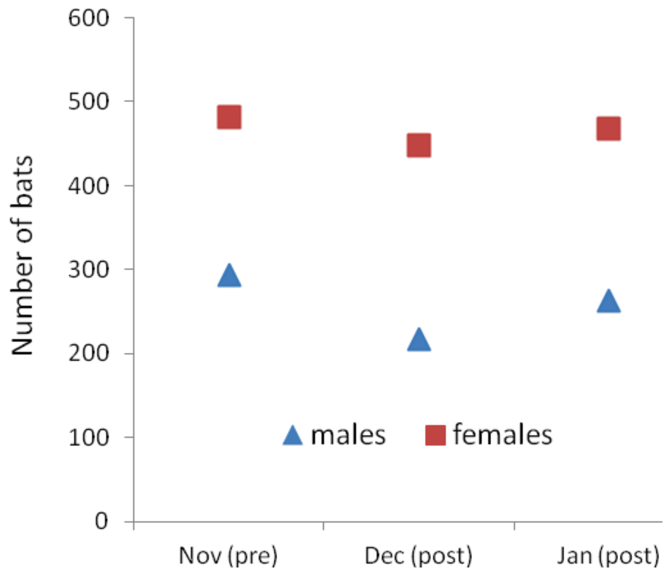
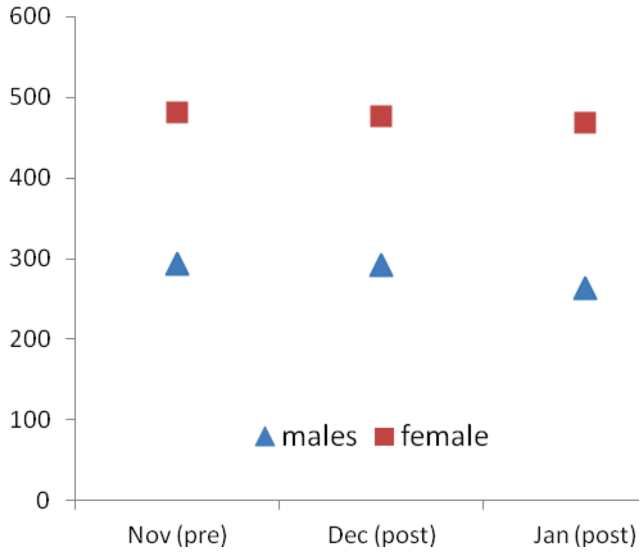


Figure 3. Modelling of the population using a model that does not allow for immigration or emigration.



Bats changed roosts frequently during November/December, however they consistently occupied roost tree M65 in the Murcott Burn. This roost tree is on a downhill lean and has an open cavity, allowing contents of the roost to spill out on the ground below. We managed to get faecal samples here before and after the 1080 operation, and found a dead baby bat, with placenta still attached. This bat tested positive for 1080 with a result of 0.013 µg/g 1080 in muscle tissue. No other dead or dying bats were found at this roost. All other roosts occupied after the 1080 operations were searched for dead or dying bats where practical using a mechanics bore scope camera. No dead or dying bats were found at these roosts.

We caught bats returning to roost trees on two occasions directly after the 1080 operation. On the 13th December at 3 am, 11 bats were captured in a mist net near occupied roost trees, none showed signs of poisoning. On the 16th of December at 2am, 19 bats were caught flying back into communal roost M55 using a harp trap. Again none showed signs of poisoning. Video recording at roosts did not show any abnormal behaviour at the roosts and subsequent video recording at roosts recorded the highest count ever at 1731 bats (Fig. 5).

4.2 Monitoring lesser short-tailed bat annual survival

Six female bats had transmitters attached to them during January. Bats were tracked to two communal roost trees in the Plato Creek area, one of these was previously unknown. Bats were still occupying the roost tree M65 in the Murcott Burn. Registrations were recorded from all three roost trees.

Survival analysis to date indicates the lesser short-tailed bat population in the Eglinton Valley are stable to increasing. The low survival rate in 2008 is likely to be related to the high rat numbers experienced in 2006/07. The slightly lowered survival in 2011 may reflect the increase in rats in October 2009, which were subsequently controlled. Rat numbers increased again in winter 2011 but were subsequently controlled. Survival rates for 2015 is not yet available as the analysis needs to compared with the following year.

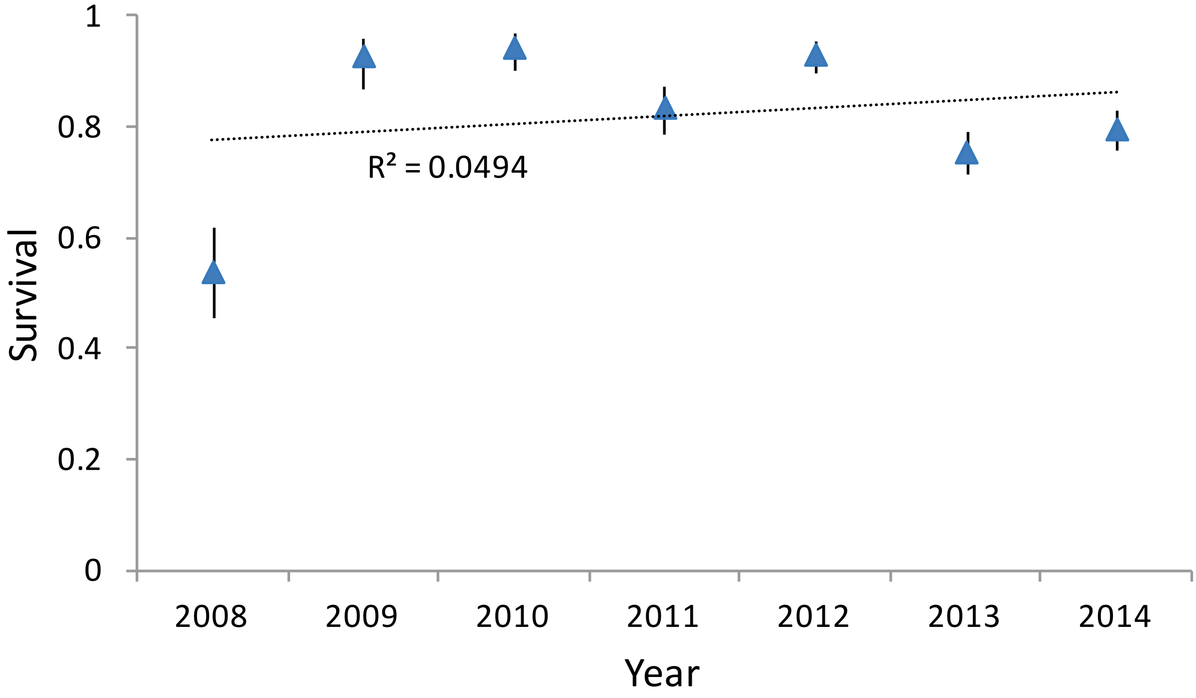


Figure 4. Survival of adult female short-tailed bats (with 95% confidence intervals) from 2008 -2014.

A total of 231 new bats of a range of age, sex and reproductive classes were PIT-tagged. This brings the total number of lesser short-tailed bats tagged in the Eglinton Valley to 1969.
All previously PIT- tagged bats handled were healthy and the majority of tags were in the correct position, between the shoulder blades.

Table 3. Captures of short-tailed bats in the Eglinton Valley 2006 - 2015

Year	total recorded	recaps	New	AF	AM	JF	JM	unknown
2015	965	734	231	42	21	79	87	2
2014	894	649	245	90	58	45	52	0
2013	758	552	206	124	31	25	26	0
2012	833	609	224	71	35	45	71	2
2011	666	439	227	93	41	48	45	0
2010	561	311	250	95	48	51	55	1
2009	377	231	146	60	56	9	13	8
2008	240	91	149	44	49	16	20	20
2007	285	6	279	128	59	48	39	5
2006	12	0	12	5	2	4	1	0
Total pit-tagged			1969					

Ten new roost trees (9 communal) were discovered during November to January, bringing the total number of roost trees found since 1997 to 98.
Emergence was recorded from two roost trees over 17 nights in January (two roosts were occupied simultaneously over one night). The largest count was 1731 individual bats from one roost tree. The video counts over the years can be seen in figure 1.

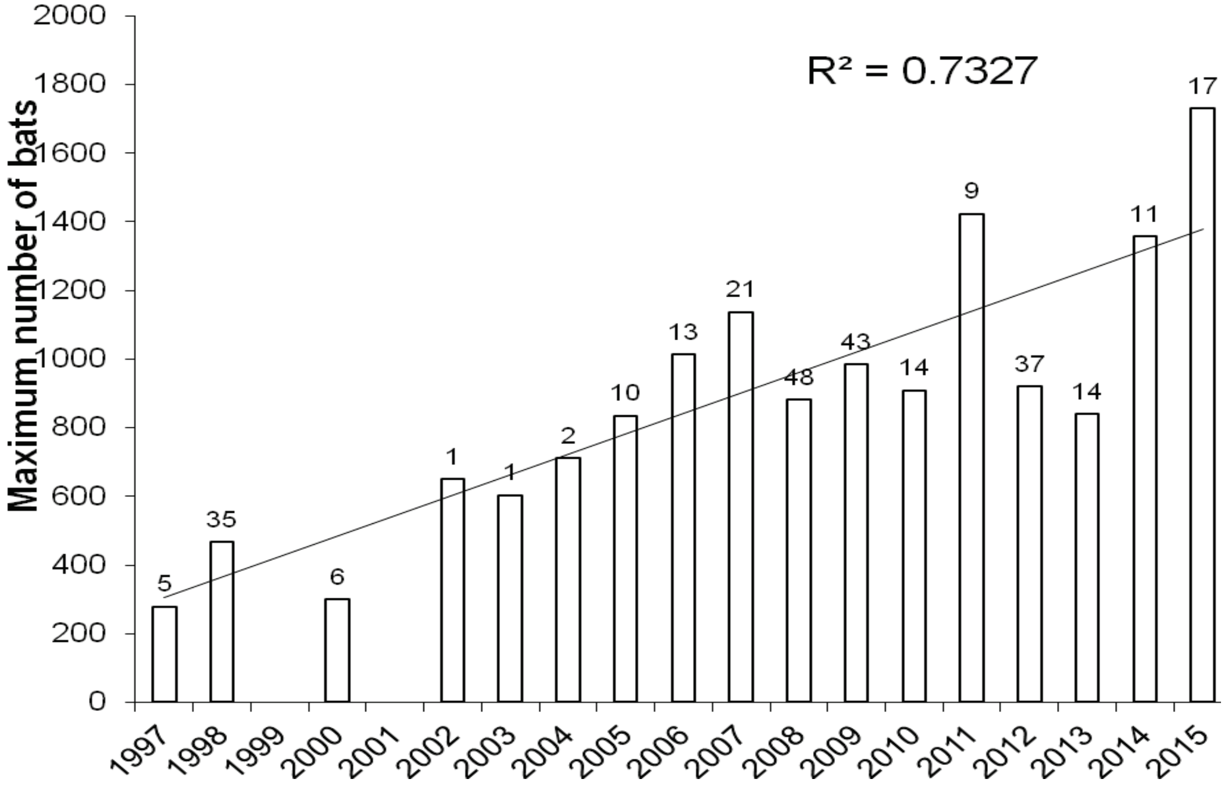


Figure 5. Graph showing maximum number of bats exiting roosts per year. Maximum number is the highest count recorded that year at either a single roost tree or the sum of roosts occupied simultaneously. The figure above each bar is the number of video counts. Note this method is an index only, it is not a true representation of the population.

5. Discussion

The highest ever count of short-tailed bats in the Eglinton Valley was recorded on video after the 1080 drop. In addition at least 98.6% of the individually recorded short-tailed bats recorded immediately prior to deployment of the 1080 in December were still alive. Modelling of the population showed that any decline of survival was due to immigration or emigration of predominantly males rather than deaths. Observations of bats on the feeding grounds and directly from roosts showed no adverse immediate effects from the toxin however there was one dead baby bat that 1080 was detected in the muscle tissue. It is not known if 1080 caused the death of this young bat. These results imply that 1080 did enter the system of at least one adult female bat and the toxin was presumably passed onto the young via the mother's milk. This was the only case recorded and the toxin had no other obvious detectable effects on the population of lesser short-tailed bats in the Eglinton Valley. Tag loss has been discovered to be a problem at the North Island short-tailed bat monitoring site (Pureora) with 40 tags dropped which had been in bats for various lengths of time (Thurley *pers. comm.)*. A search of dropped tags was made at two accessible roosts in the Eglinton and only one old tag was discovered. This requires further investigation as if a significant number of tags are being lost then it will affect the confidence in the survival rates.

6. Recommendations

We recommend the Eglinton lesser short-tailed bat project continues in its current form as a long-term project for the following reasons:

- Annual monitoring of the lesser short-tailed bat population in the Eglinton Valley is essential to test whether there are any long-term effects of 1080 and pindone poisons
- Annual marking of a proportion of the lesser short-tailed bat population is required for the mark-recapture method
- Outcome monitoring of the lesser short-tailed bats complements the suite of threatened species monitoring in the Eglinton Valley, resulting in a unique project with one of the longest histories and the broadest scope in the country
- The lesser short-tailed bat population in the Eglinton Valley is currently the only known population in existence on mainland South Island, being actively protected by pest control and studied

7. Acknowledgements

Thank-you to all who were involved in this season's fieldwork: Thanks to the lesser short-tailed bat monitoring team; Warren Simpson, Moira Pryde, Sanjay Thakur and Hannah Edmonds. Thank- you to our PIT-taggers: Jane Tansell and Linda Kilduff, handlers: Dane Simpson, Chloe Corne and Phil Marsh, scribes and useful people: Lara McBride, Jazz Beckett, Colin O'Donnell, Lucy Rossiter, Peter Kirkman, Mihoko Wada, John Whitehead, Jason Van De Wetering, Rebecca Jackson, Sophie Penniket.

Thanks to Contract Wild Animal Control and Gerard Hill and his team of contractors for controlling pests in the valley. Thank – you to Lindsay Wilson and Em Oyston for management support. Thank-you to Moira Pryde for data analysis and technical support.

8. References

Hill, G. 2013. Threatened species protection in the Eglinton Valley, annual report 2012/13. Unpublished report, Department of Conservation, Te Anau (DOCDM-1222347).

Lloyd, B. McQueen, S. 2002. Measuring mortality in short-tailed bats (*Mystacina tuberculata*) as they return from foraging after an aerial 1080 possum control operation. *New Zealand Journal of Ecology* **26:** 53-59.

Lloyd, B. 1995. A report on a trial of the effects of forearm banding on captive short-tailed bats *Mystacina tuberculata*. Unpublished Science & Research Report, Department of Conservation, Wellington.

O'Donnell CFJ 2002. Timing of breeding, productivity and survival of long-tailed bats *Chalinolobus tuberculatus* (Chiroptera: Vespertilionidae) in cold-temperate rainforest in New Zealand. Journal of Zoology, London 257: 311–323.

O'Donnell CFJ 2009. Population dynamics and survivorship in bats. Ecological and Behavioral Methods for the Study of Bats, 158-176.

O'Donnell, C.F.J.; Christie, J.E., Hitchmough, R.A., Lloyd, B. & Parsons, S. 2010. The conservation Status of New Zealand Bats. 2009. *New Zealand Journal of Zoology* **37:** 297-311.

Pryde, M.A.; Lettink, M. & O'Donnell, C.F.J. 2006. Survivorship in two populations of long-tailed bats (*Chalinolobus tuberculatus*) in New Zealand. *New Zealand Journal of Zoology* **33:** 85–95.

Pryde, M.A.; O'Donnell, C.F.J. & Barker, R.J. 2005. Factors influencing survival and long-term population viability of New Zealand long-tailed bats (*Chalinolobus tuberculatus*): Implications for conservation. *Biological Conservation* **126**: 175–185.

Sedgeley, J.A. & Anderson, M. 2000. Capture and captive maintenance of short-tailed bats on Whenua Hou and monitoring of wild bats during the kiore eradication programme winter 1998. Internal Report, Department of Conservation, Invercargill. Pp. 47.

Sedgeley, J. & O'Donnell, C. 2006. Results and recommendations from transponder trials in lesser short-tailed bats. Unpublished Report, RD&I, Department of Conservation, Christchurch.

Sedgeley, J. & O'Donnell, C. 2007. Use of Passive Integrated Transponder tags to Mark and Monitor Lesser Short-tailed Bats in the Eglinton Valley. Report to DOC Animal Ethics Committee (2007). Unpublished Report, RD&I, Department of Conservation, Christchurch.

Sedgeley, J. 2008. Eglinton Valley lesser short-tailed bat monitoring programme. (Report for Operation Ark Meeting April 2008). Unpublished Report, R&D, Department of Conservation, Christchurch.

Sedgeley, J.; O'Donnell, C., Lyall, J., Edmonds, H., Simpson, W., Carpenter, J., Hoare, J. & McInnes, K. 2012. DOC Best Practise Manual of Conservation Techniques for Bats. Inventory and Toolbox: Bats (http://www.doc.govt.nz/Documents/science-and-technical/inventory-monitoring/im-toolbox-bats/im-toolbox-bats-doc-best-practise-manual-of-conservation-techniques-for-bats.pdf

Appendix 1. Map of lesser short-tailed bat roost trees and aerial 1080 operation area 2014